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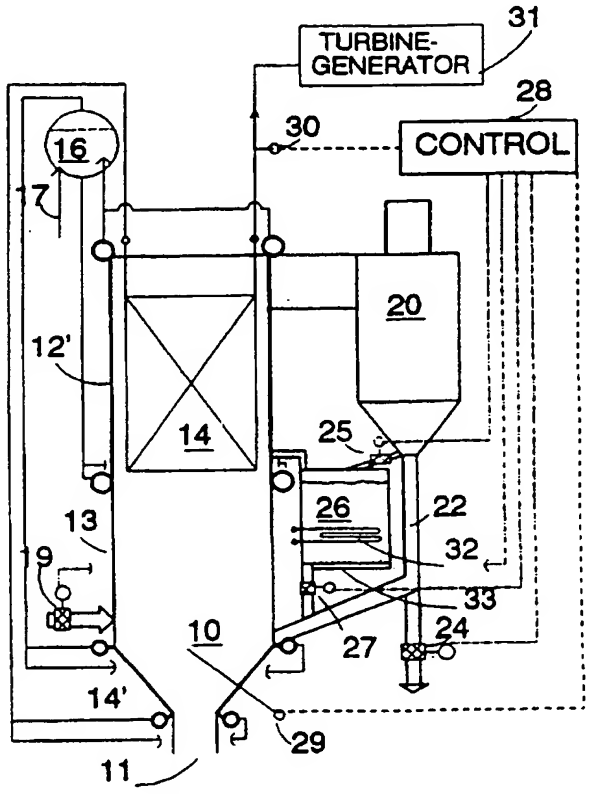
(54) Title: METHOD OF REGULATING THE SUPERHEATING TEMPERATURE OF STEAM IN A CIRCULATING FLUIDIZED BED TYPE GAS COOLER

(57) Abstract

The present invention refers to a method of regulating the steam superheating temperature in a circulating fluidized bed type gas cooler. Hot gas is introduced into a mixing chamber, where it is mixed with solids having a temperature lower than that of the gas, whereby the temperature of the mixing chamber settles to a mixing temperature. The mixture of the gas and solids is taken from the mixing chamber via a riser to a solids separator, heat being thereby cooling the mixture of gas and solids and transferring heat to heat transfer surfaces. Solids are separated from the gas in the separator and recirculated into the mixing chamber. In connection with the cooling of the gas, superheated steam is generated in evaporators and superheaters arranged in the cooler. The mixing temperature in the mixing chamber, according to the invention, is utilized for temperature regulation of the superheated steam generated in connection with the gas cooling. The mixing temperature may be regulated by controlling the amount and temperature of solid material being introduced into the mixing chamber.



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METHOD OF REGULATING THE SUPERHEATING TEMPERATURE OF STEAM IN A CIRCULATING FLUIDIZED BED TYPE GAS COOLER

The present invention relates to a method of regulating the superheating temperature of steam in a circulating fluidized bed type gas cooler, which comprises in the lower section thereof a mixing chamber for the circulating material and the gas to be cooled; a riser in communication with the mixing chamber; a separator in communication with the riser, for separating solids from the gases; means for introducing the separated solids into the mixing chamber; and means for generating and superheating steam; in which method gas is introduced into the mixing chamber where it is mixed with solids having a temperature lower than that of the gas, whereby the temperature of the mixing chamber settles to a mixing temperature, the mixture of the gas and solids is taken to the riser and further to the solids separator where solids are separated from the gas, separated solids are thereafter introduced into the mixing chamber and, in connection with the cooling of the gas, superheated steam is generated.

This kind of method is applicable to the cooling systems of many types of hot gases. E.g., a Finnish patent application 813717 (FI patent 64997) teaches cooling of gas in a circulating fluidized bed reactor. It discloses a method of recovering heat from a gas containing vaporized, molten, and eutectic components by bringing the gas into contact with heat transfer surfaces of a heat exchanger, whereby heat recovery based on so-called controlled erosion is explained to happen by lowering the gas temperature before the heat exchanger to a value below the eutectic temperature range of the melt drops so that solid particles which have cooled in the heat

exchanger, separated from the gas and circulated, and possibly also other particles, are mixed with the gas.

Finnish patent application 843606 discloses a method of cleaning gases containing condensable components, in which method the gases are cleaned by cooling them in a circulating fluidized bed reactor so that the components condense onto the surface of solids in the reactor.

Methods similar or corresponding to the ones described above may in some cases be applied to the generation of superheated steam also (for generation of electricity by means of a turbine generator unit). With saturated steam, electricity is generated at a poor conversion ratio. Use of a steam turbine sets certain demands; e.g., for structural reasons, the temperature of the inlet steam generally has to be kept constant, and deviations of more than a few degrees are not allowable.

A conventional way of regulating the temperature of superheated steam is to divide the superheating surfaces into at least two parts and to arrange controlled steam cooling between these parts. It is common to arrange the required cooling, e.g., by injecting condensate, or by leading steam, e.g, through a heat exchanger disposed in the water space of the steam drum. A way of regulating the temperature of the superheated steam is to pass by the superheater.

However, arrangements of this kind call for relatively complicated engineering, which among other things adds to investment costs. Further, injection may cause, e.g. fouling of superheater surfaces, especially, if the water contains impurities.

It is an object of the present invention to provide an improved and simpler method in comparison with the prior art of regulating the superheating temperature of the steam in circulating fluidized bed type gas coolers.

It is another object of the present invention to provide a method of regulating the superheating temperature of steam in a circulating fluidized bed type gas cooler in which method the drawbacks of prior art have been eliminated.

It is a further object of the present invention to provide a method of regulating the superheating temperature of steam in a circulating fluidized bed type gas cooler, which method is implemented with a simple equipment.

The method of the present invention of regulating the superheating temperature of steam in a circulating fluidized bed type gas cooler is mainly characterized by the utilization of the mixing temperature for temperature regulation of the superheated steam produced in connection with gas cooling.

A circulating fluidized bed type gas cooler according to a preferred embodiment of the invention comprises in the lower section thereof a mixing chamber for the circulating material and the gas to be cooled; a riser in communication with the mixing chamber; a solids separator in communication with the riser, for separating solids from the gases; means for introducing the separated solids into the mixing chamber; and means for generating steam and for superheating it; whereby the gas to be cooled is introduced into the mixing chamber via a gas inlet. Gas preferably serves as a fluidizing gas in the cooler. In the mixing chamber, the gas is mixed with solids having a temperature lower than that of the gas, whereby the tem-

perature of the gas/solids suspension formed settles to a so-called mixing temperature. The mixture of gas and solids is taken to the riser and further to a solids separator where solids are separated from the gas. Separated solids are fed to the mixing chamber.

In accordance with the invention, superheated steam is generated in connection with the gas cooling, and the temperature of this superheated steam is regulated by utilizing the value and regulation of the mixing temperature. Preferably, the temperature of the superheated steam is regulated by regulating the mixing temperature, which mixing temperature again is regulated, in accordance with the invention, by controlling the amount and/or temperature of the solids returned to the mixing chamber.

In accordance with the invention, the superheating temperature of the steam may be influenced by carrying out any of the following functions:

- decrease the volume of the solids flow by leading the solids flow into the solids chamber, whereby the mixing temperature will rise as a result of the decreased solids flow;
- decrease the volume of the solids flow by taking the solids flow out of the gas cooler, whereby the mixing temperature will rise as a result of the decreased solids flow;
- increase the volume of the solids flow by taking solids out of the solids chamber, whereby the mixing temperature will drop as a result of the increased solids flow;
- increase the volume of the solids flow by bringing new solids into the cooler, whereby the mixing temperature will drop as a result of the increased solids flow.

In accordance with the invention, the superheating temperature of steam may also be influenced by cooling

solids in a solids chamber so that heat is transferred from the solids to a heat transfer medium. This cooling manner speeds up the regulation of the superheating temperature. In this case, the solids chamber may be provided with a bubbling fluidized bed. Solids may also be cooled simply so that the walls of the solids chamber are of a cooled construction.

In accordance with the invention, solid material may be cooled prior to separating it from the gas, as a gas suspension, preferably by heat transfer surfaces disposed in the riser or in the mixing chamber.

The invention will be described in further detail below, by way of example, with reference to the accompanying drawings, in which

Fig. 1 illustrates a gas cooler based on the circulating fluidized bed concept and being in accordance with the method of the invention, and

Fig. 2 illustrates a second gas cooler based on the circulating fluidized bed concept and being in accordance with the method of the invention.

Fig. 1 shows an exemplary gas cooler applying the circulating fluidized bed concept, which gas cooler comprises in the lower section thereof a mixing chamber 10 for the gas to be cooled and for the circulating material, and an inlet 11 to the mixing chamber, for the gases to be cooled. Above the mixing chamber and in connection therewith is disposed a riser 13, the upper section whereof is in communication with a solids separator 20 for separating solids from the gases. Furthermore, the equipment comprises means for introducing the separated solids into the mixing chamber, which means consist of a

return duct 22 and a solids chamber 26 connected in parallel therewith, and solids discharge means 24. The equipment is also provided with heat transfer surfaces 12, 14, disposed in the riser, for generating steam and for superheating it, respectively, a steam drum 16, and a steam generating circulation system, equipped with a circulating pump 18. The above is a description of an exemplary forced steam circulation.

Hot gas is introduced via inlet 11 into the mixing chamber 10, where it is efficiently mixed with the solids fed to the mixing chamber. Gas preferably serves as a fluidizing gas in the cooler. The mixing temperature is observed by a measuring element 29, which transmits a measuring signal to a controlling member 28. From the mixing chamber, the gas/solids suspension, being cooled by heat exchangers 12 and 14, passes via riser 13 to the upper section thereof. The heat exchangers have vaporizing surface 12 and superheating surface 14. It is also possible to use other cooling surfaces, such as a preheater of feed water or an air heater in the riser. The gases are led from the upper section of the riser to the solids separator 20, where solids are separated from the gas. From the separator, the gases are taken to a further treatment via conduit 21. Solids are recirculated to the mixing chamber via return duct 22.

The gas cooler is also provided with a solids chamber 26, whereinto material may be led from the mass circulation and wherefrom material may be taken along with the circulation if necessary. In the feed conduit of the solids chamber is disposed a valve 25 for controlling the feed of the material into the chamber. The controlling member 28 controls the function of the valve 25. The outlet conduit from the solids chamber is also provided with a valve 27, for controlling the feed of the material back

to the mass circulation, preferably by means of controlling member 28. New material can be introduced into the process via conduit 19, which is disposed in connection with the return duct, on the inclined portion thereof, which is in communication with the mixing chamber. Most preferably, the conduit 19 is connected with the solids chamber 26. Fig. 1 shows a conduit to both chambers, but it is naturally sufficient to have one of the conduits. Introduction of new material is also controlled by controlling member 28. The above-mentioned valves are controlled by the controlling member, whereby the regulation of the superheating temperature is implemented in a very advantageous manner.

The chamber 26 may be used for altering the amount of circulating material. By utilizing the chamber, the regulation of the mixing temperature may be speeded up so that more circulating material from the chamber is taken to the mass circulation or so that part of the solids from the mass circulation is led to the chamber. Often the amount of solids (dust) contained in the gas to be cooled is so plentiful that it adds to the solids amount in the mass circulation of the cooler; in other words, the circulating fluidized bed type gas cooler separates more inlet dust to its circulation than what remains unseparated in its exhaust gases. Thus, solids have to be discharged from the mass circulation by valve 24. This valve is also controlled by controlling member 28.

For generating superheated steam, feed water is introduced into the steam drum 16 via conduit 17. The steam drum is in communication with a steam generating circulation system. The steam generating circulation system comprises circulating pump 18 and vaporizing surfaces 12, which vaporizing surfaces are preferably disposed in the riser 13 of the cooler. The generated steam is super-

heated on superheating surfaces 14, which are also disposed in the riser 13. The temperature of the superheated steam is kept substantially constant; the allowable deviation from the set value is normally only about +/- 5°C.

The superheated steam is led to the turbine generator unit 31, wherefrom condensed steam may be returned to the feed water conduit 17.

When the gas to be cooled contains so little solids (dust) that the mass circulation has to be maintained by feeding more solids thereto, the regulation of the superheating temperature is so effected that, when raising the superheating temperature, solids are taken into the chamber 26 or out via discharge means 24. Use of the chamber is, however, more advantageous because it lessens the need for new solids. When the superheating temperature is desired to be decreased by increasing the amount of solids in the mass circulation, solids are taken from chamber 26. The amount of solids in chamber 26 is maintained at a suitable level by feeding more solids to the chamber or by discharging them. In the cases in which the amount of circulating mass increases because of the new material entrained with the gas, solids have to be discharged from the circulation.

Fig. 2 shows an exemplary arrangement which is mainly similar to the arrangement shown in Fig. 1, but it illustrates vaporizing surfaces 12' as part of the structure of the equipment itself, and the steam circulation is arranged as a so-called natural circulation. It is appreciated from Fig. 2 that the wall of the riser 13 forms vaporizing surface 12'. Also other parts of the cooler may be of a cooled construction. In Fig. 2, superheating surface 14' is arranged in connection with the mixing

chamber. This arrangement is exemplary and, e.g., the surfaces may naturally be disposed in different ways.

Fig. 2 additionally shows a heat transfer element 32 disposed in chamber 26, which heat transfer element is capable, e.g., of cooling solids in chamber 26 if this is necessary for the regulation of superheated steam. In that case, the chamber is preferably provided with feeding means 33 for fluidizing gas. The regulation of the steam superheating temperature may thus be speeded up by cooling solids in the solids chamber 26 so that heat is transferred from the solids to a heat transfer medium, which flows inside the element 32. In this case, the solids chamber is preferably provided with a bubbling fluidized bed by bringing fluidizing gas thereinto by feeding means 33. Feeding means 33 preferably comprise a gas distribution plate or a grate, below which is a gas distribution chamber, whereinto fluidizing gas is introduced in a controlled manner; if desired, fluidizing does not exist in this arrangement at all. In the arrangement of Fig. 2, new material is introduced into the process via conduit 19 direct to the mixing chamber. Controlling member 28 also controls the function of conduit 19.

Figs. 1 and 2 illustrate controlling members 24, 25 and 27 as valves, but it is, however, clear that these can also be arranged non-mechanically if so desired, whereby they utilize, e.g., the solids bed/column for bringing about a valve effect. Furthermore, it is evident to a person skilled in the art that the superheating surfaces 14, 14' may be disposed in the most appropriate place in the equipment; they need not necessarily be integrated in the riser wall or in the mixing chamber of the gas cooler. The vaporizing and superheating surfaces may also be disposed one after the other in the riser.

The functioning of the superheating temperature regulation is preferably controlled by controlling member 28, which has connections with at least the following elements: conduit 19 for introducing new material into the mixing chamber, solids chamber or return duct; valve 25 disposed in the feeding conduit of the solids chamber; valve 27 disposed in the outlet conduit of the solids chamber and solids discharge means 24; sensing element 29 measuring the temperature of the mixing chamber; and sensing element 30 measuring the temperature of superheated steam.

Thus, the temperature of superheated steam is regulated by controlling member 28, whereby control signals are transmitted from the controlling member to at least the following elements: conduit 19 for introducing new material into the mixing chamber or return duct; valve 25 disposed in the feeding conduit of the solids chamber; valve 27 disposed in the outlet conduit of the solids chamber and solids discharge means 24; and which controlling member 28 receives measuring signals from at least the sensing element 29 measuring the temperature of the mixing chamber and from the sensing element 30 measuring the temperature of superheated steam.

The method for regulating the temperature of superheated steam can advantageously by used when cooling high temperature process gases generated in e.g. combustion processes, metallurgical smelting processes or chemical processes.

The above description is by no means intended to limit the invention, but it comprises the variations within the scope of the invention evident to a person skilled in the art and defined by the accompanying claims.

CLAIMS

1. A method of regulating the superheating temperature of steam in a circulating fluidized bed type gas cooler, which comprises in the lower section thereof a mixing chamber for the circulating material and the gas to be cooled; a riser in communication with the mixing chamber; a separator in communication with the riser, for separating solids from the gases; means for introducing the separated solids into the mixing chamber; and means for generating and superheating steam; in which method
- hot gas is introduced into the mixing chamber, where it is mixed with solids having a temperature lower than that of the gas, whereby the temperature of the mixing chamber settles to a mixing temperature,
- the mixture of the gas and solids is taken to the riser and further to the solids separator where solids are separated from the gas,
- separated solids are thereafter introduced into the mixing chamber and
- in connection with the cooling of the gas superheated steam is generated,
the method being characterized by
utilizing the mixing temperature for temperature regulation of the superheated steam generated in connection with the gas cooling.

2. A method of regulating the superheating temperature according to claim 1, characterized by
the temperature of the superheated steam being regulated by regulating the mixing temperature, which mixing temperature is regulated by controlling the amount of solids returned to the mixing chamber.

3. A method of regulating the superheating temperature according to claim 1, characterized by the temperature of

the solids being increased in the mixing chamber and decreased in the riser.

4. A method of regulating the superheating temperature according to claim 1, characterized by the temperature of the superheated steam being regulated by regulating the mixing temperature, which mixing temperature is regulated by controlling the temperature of solids returned to the mixing chamber.

5. A method of regulating the superheating temperature according to claim 2 in a circulating fluidized bed cooler, in which means for leading separated solids into the mixing chamber include a return duct and parallel connected thereto a solids chamber, a solids discharge conduit and a conduit for introducing new solid material, characterized by the superheating temperature of the steam being influenced by carrying out one of following functions:
- decreasing the volume of solids flow by leading solids from the flow into the solids chamber,
- decreasing the volume of the solids flow by taking out solids thereof from the gas cooler,
- increasing the volume of the solids flow by introducing solids from the solids chamber into the flow or
- increasing the volume of the solids flow by bringing new solids into the flow in the cooler.

6. A method of regulating the superheating temperature according to claim 4 in a circulating fluidized bed cooler, in which means for leading separated solids into the mixing chamber include a solids chamber with solids cooling elements, characterized by the superheating temperature of the steam being influenced by carrying out one of following functions:
- solid material is cooled prior to leading it into the mixing chamber,

- solid material is cooled in a solids chamber,
- solid material is cooled prior to separating it from the gas,
- solid material is cooled after it being separated from the gas.

7. A method according to claim 1, characterized by steam being generated in at least heat transfer surfaces disposed in the riser.

8. A method according to claim 7, characterized by steam being superheated in heat transfer surfaces disposed in the riser.

9. A method according to claim 7, characterized by steam being superheated in heat transfer surfaces arranged in the mixing chamber.

10. A method according to claim 5, characterized by the temperature of superheated steam being controlled by a controlling member, whereby
- control signals are transmitted from the controlling member to controlling elements in at least: a conduit for introducing new solid material into the mixing chamber or into the return duct, a valve disposed in the feeding conduit of the solids chamber, a valve disposed in the outlet conduit of the solids chamber and in the solids discharge conduit, and
- measuring signals are received by the controlling member from the sensor measuring the temperature of the mixing chamber and the sensor measuring the temperature of the superheated steam.

AMENDED CLAIMS

[received by the International Bureau on 2 May 1996 (02.05.96); original claim 8 cancelled; original claim 1 amended; claims 9-10 renumbered as claims 8-9 other claims unchanged (3 pages)]

1. A method of regulating the superheating temperature of steam in a circulating fluidized bed type gas cooler, which comprises in the lower section thereof a mixing chamber for the circulating material and the gas to be cooled; a riser in communication with the mixing chamber; a separator in communication with the riser, for separating solids from the gases; means for introducing the separated solids into the mixing chamber; and means for generating and superheating steam; in which method

- hot gas is introduced into the mixing chamber, where it is mixed with solids having a temperature lower than that of the gas, whereby the temperature of the mixing chamber settles to a mixing temperature,
- the mixture of the gas and solids is taken to the riser and further to the solids separator where solids are separated from the gas,
- separated solids are thereafter introduced into the mixing chamber and
- in connection with the cooling of the gas superheated steam is generated,

the method being characterized by

- steam being superheated in heat transfer surfaces disposed in the riser and
- controlling the temperature of the superheated steam being generated in the riser by regulating the mixing temperature in the mixing chamber.

2. A method of regulating the superheating temperature according to claim 1, characterized by

the temperature of the superheated steam being regulated by regulating the mixing temperature, which mixing temperature is regulated by controlling the amount of solids returned to the mixing chamber.

3. A method of regulating the superheating temperature according to claim 1, characterized by the temperature of the solids being increased in the mixing chamber and decreased in the riser.

4. A method of regulating the superheating temperature according to claim 1, characterized by
the temperature of the superheated steam being regulated by regulating the mixing temperature, which mixing temperature is regulated by controlling the temperature of solids returned to the mixing chamber.

5. A method of regulating the superheating temperature according to claim 2 in a circulating fluidized bed cooler, in which means for leading separated solids into the mixing chamber include a return duct and parallel connected thereto a solids chamber, a solids discharge conduit and a conduit for introducing new solid material, characterized by
the superheating temperature of the steam being influenced by carrying out one of following functions:
- decreasing the volume of solids flow by leading solids from the flow into the solids chamber,
- decreasing the volume of the solids flow by taking out solids thereof from the gas cooler,
- increasing the volume of the solids flow by introducing solids from the solids chamber into the flow or
- increasing the volume of the solids flow by bringing new solids into the flow in the cooler.

6. A method of regulating the superheating temperature according to claim 4 in a circulating fluidized bed cooler, in which means for leading separated solids into the mixing chamber include a solids chamber with solids cooling elements, characterized by
the superheating temperature of the steam being influenced by carrying out one of following functions:

- solid material is cooled prior to leading it into the mixing chamber,
- solid material is cooled in a solids chamber,
- solid material is cooled prior to separating it from the gas,
- solid material is cooled after it being separated from the gas.

7. A method according to claim 1, characterized by steam being generated in at least heat transfer surfaces disposed in the riser.

8. A method according to claim 7, characterized by steam being superheated in heat transfer surfaces arranged in the mixing chamber.

9. A method according to claim 5, characterized by the temperature of superheated steam being controlled by a controlling member, whereby
- control signals are transmitted from the controlling member to controlling elements in at least: a conduit for introducing new solid material into the mixing chamber or into the return duct, a valve disposed in the feeding conduit of the solids chamber, a valve disposed in the outlet conduit of the solids chamber and in the solids discharge conduit, and
- measuring signals are received by the controlling member from the sensor measuring the temperature of the mixing chamber and the sensor measuring the temperature of the superheated steam.

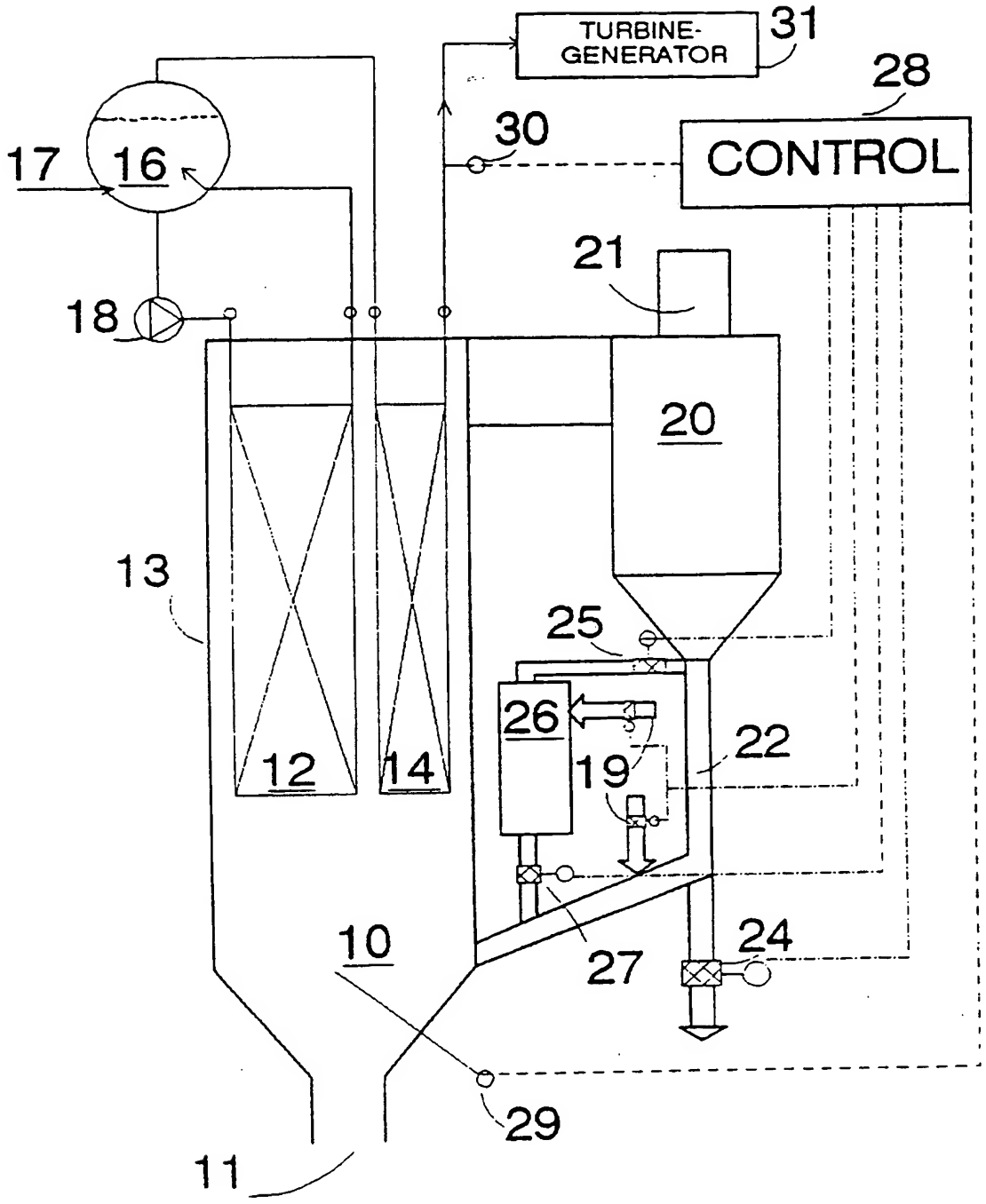

FIG. 1

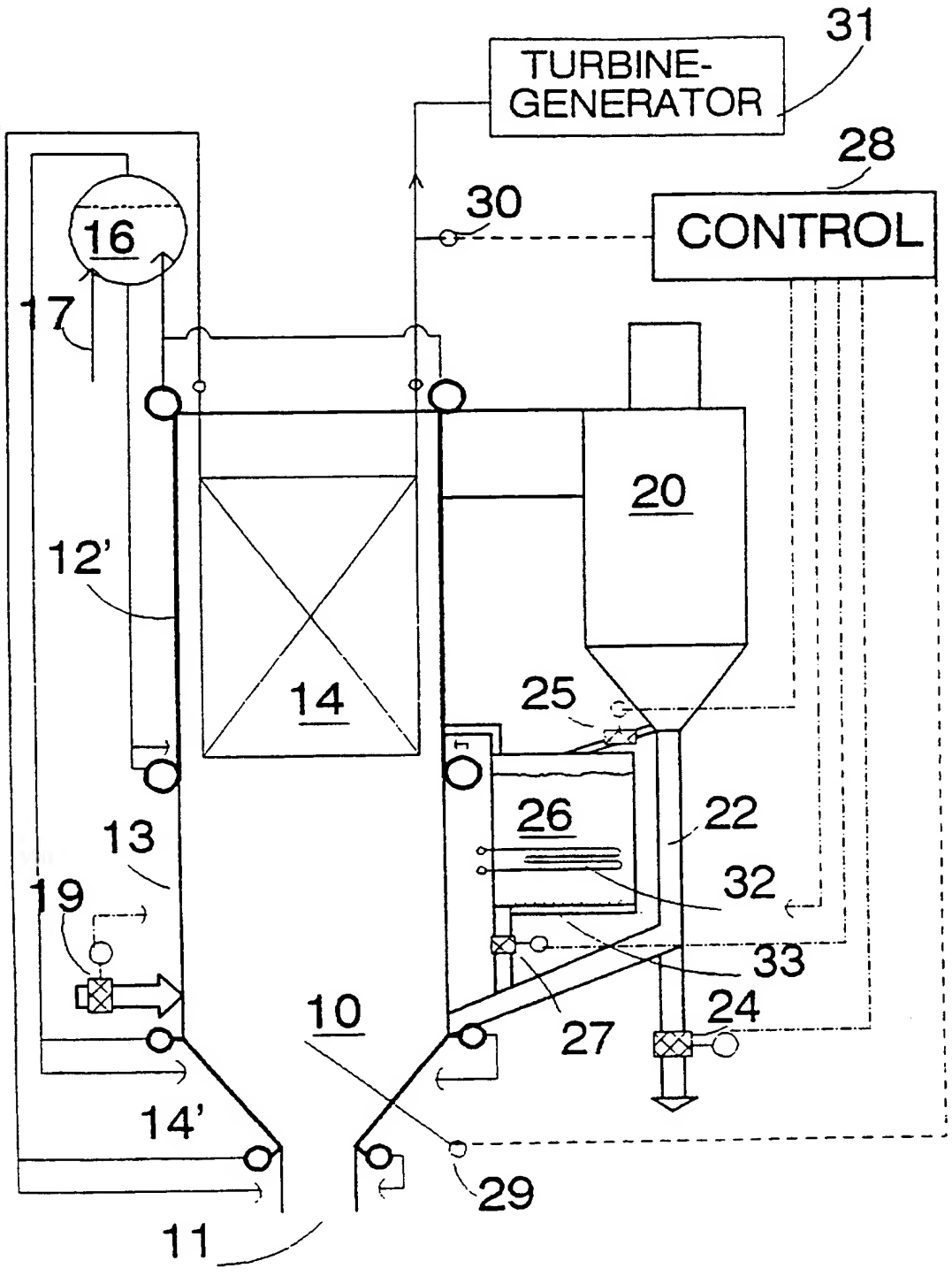

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 95/00627

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F28D 13/00, F22G 5/00, F23C 11/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F28D, F22G, F23C, F28F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4538549 A (STRÖMBERG), 3 Sept 1985 (03.09.85), claim 26 --	1,2,3
X	US 4672918 A (ENGSTROM ET AL), 16 June 1987 (16.06.87) --	1,4,6
A	US 4312301 A (ANSON), 26 January 1982 (26.01.82) --	
A	US 4453495 A (STROHMEYER, JR.), 12 June 1984 (12.06.84) --	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
13 March 1996	15 -03- 1996
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Magnus Thorén Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 95/00627

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4473032 A (MAINTOK), 25 Sept 1984 (25.09.84) --	
A	US 4552203 A (CHRYSOSTOME ET AL), 12 November 1985 (12.11.85) --	

INTERNATIONAL SEARCH REPORT
Information on patent family members

05/02/96

International application No.
PCT/FI 95/00627

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4538549	03/09/85	CA-A- 1225292	11/08/87
		CA-A- 1240888	23/08/88
		CA-A- 1240889	23/08/88
		DE-A- 3382559	11/06/92
		EP-A,B,B 0103613	28/03/84
		SE-T3- 0103613	
		EP-A,A,A 0158033	16/10/85
		SE-T3- 0158033	
		JP-C- 1780842	13/08/93
		JP-A- 2008601	12/01/90
		JP-B- 3071601	13/11/91
		JP-B- 4072122	17/11/92
		JP-T- 59500383	08/03/84
		US-A- 4686939	18/08/87
		WO-A- 8303294	29/09/83
US-A- 4672918	16/06/87	AT-A- 154285	15/01/96
		AU-B,B- 558645	05/02/87
		AU-A- 4262485	28/11/85
		CA-A- 1259859	26/09/89
		DE-A,C,C 3517987	28/11/85
		FR-A,B- 2564747	29/11/85
		GB-A,B- 2160119	18/12/85
		JP-C- 1685141	31/07/92
		JP-B- 3048406	24/07/91
		JP-A- 61049913	12/03/86
		KR-B- 9310857	15/11/93
		SE-B,C- 462933	17/09/90
		SE-A- 8502498	26/11/85
US-A- 4312301	26/01/82	AT-E,T- 10133	15/11/84
		AU-B,B- 536859	24/05/84
		AU-A- 6788281	07/08/81
		CA-A- 1141972	01/03/83
		EP-A,B- 0033713	12/08/81
		SE-T3- 0033713	
		WO-A- 8101970	23/07/81
US-A- 4453495	12/06/84	US-A- 4454838	19/06/84
		US-A- 4473033	25/09/84

INTERNATIONAL SEARCH REPORT
Information on patent family members

05/02/96

International application No.
PCT/FI 95/00627

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4473032	25/09/84	AT-E,T- 10673	15/12/84
		AU-B,B- 553068	03/07/86
		AU-A- 8504482	06/01/83
		CA-A- 1190815	23/07/85
		DE-A,C,C 3125849	20/01/83
		EP-A,B,B 0068301	05/01/83
		SE-T3- 0068301	
US-A- 4552203	12/11/85	EP-A,B- 0093063	02/11/83
		SE-T3- 0093063	
		FR-A,B- 2526182	04/11/83